ICRISAT REPORTS

Groundnut Research at ICRISAT as Related to Asia

J. A. Wightman and S. N. Nigam

Legumes Program

Introduction

This paper is an overview of the activities of the Groundnut Group at ICRISAT since our meeting in 1988 which have had the most impact on helping the NARSs promote groundnut production in Asia. Considering the small size of our Group, our contact time and activity in Asia has been at a high level over the last two years. We consider ourselves still to be at the stage of defining constraints; so there is still a need to collect more information about how much yield loss can be attributed, in absolute terms, to the different constraints. But first, some words about the Group personel at ICRISAT Center.

The Groundnut Group is divided into six discipline units; all but the Breeding Unit has multicrop responsibilities. In addition, we function as part of AGLN and LEGOFTEN.

The scientific staff most concerned with groundnut are (Unit Leader first):

Breeding: S.N. Nigam, L.J. Reddy, and S.L. Dwivedi

Cell Biology: J.P. Moss and D.C. Shastri

Entomology: J.A. Wightman (currently Groundnut Group Leader) and G.V. Ranga Rao

Pathology: D.H. Smith, V.K. Mehan, and S.B. Sharma

Physiology: C. Johansen, R.C. Nageswara Rao (on sabbatic), and V.M. Ramraj

Virology: D.V.R. Reddy

LEGOFTEN: C.S. Pawar

This represents a depletion in research staff since we last met: D. McDonald is now Legumes Program Director. Resignations have come from Breeder M. J. Vasudeva Rao, Cell Biologist P. T. C. Nambiar, and LEGOFTEN Coordinator P. W. Amin. A. K. Singh

was transferred from Cell Biology to the Genetic Resources Unit to replace V. Ramanatha Rao who went to IBPGR, Rome. J. H. Williams (Principal Physiologist) and F. Waliyar (Principal Pathologist) were transferred to ISC, Niger, West Africa and P. Subrahmaniam to Malawi as Principal Pathologist. S. N. Nigam completed a one-year sabbatic assignment in North Carolina in 1990. We welcome Don Smith from Texas as Principal Legumes Pathologist.

Other administrative changes include the formation of a discrete Virology Unit and the change in name of the Cytogenetics Unit to Legumes Cell Biology to cover a broadening of responsibilities.

Activities in Asia

The most significant activity in Asia was the Groundnut Scientists' Meeting held in Malang, Indonesia, Nov 1988. Scientists from eight national programs in Asia and representatives of a range of multilateral and bilateral international research organisations met to discuss priorities. The results of this discussion have lead to changes in emphasis in the research program at ICRISAT, of Peanut CRSP, and ACIAR. The general consensus was for ICRISAT to supply 'finished' lines preadapted to conditions of the agroecological zones of each country. The minority of countries wanted segregating populations from which to select their own varieties or breeding material. The other main conclusions were the need for more input into entomological research, particularly pest surveys, and studies of methods to overcome the problems created by shading and acid soils. The last three topics were discussed in detail at a workshop hosted by the Philippine National Program in Los Baños in Apr 1990. The workshop was attended by representatives from other Asian countries, as well as Peanut CRSP, ACIAR, and ICRISAT.

The Agroclimatology Workshop that was held at ICRISAT Center in Dec 1988 also modified the research approach of the Groundnut Group. A subsequent visit by a consultant from Canada gave us additional information about how we can become more effective in our support of Asian NARSs through a GIS. We await the installation of a GIS and the initiation of constraint (pest and disease) surveys in Asia to help us integrate our knowledge about the problems of the region as a whole.

New contacts have been made and consolidated in Asia as a result of training courses, traveling workshops, and constraint analysis missions, for example, in Bangladesh, Myanmar, the People's Republic of China, Vietnam, and Taiwan. This has been achieved without losing contact with long-standing 'core' cooperators. We look forward to investigating further the possibility of increasing our ability to support groundnut production in Malaysia, Cambodia, and perhaps Bhutan.

A meeting in Jan 1990 between representatives of the ICAR, AICORPO, the (Indian) National Research Centre for Groundnut (NRCG), and ICRISAT groundnut scientists established a series of joint projects that are being carried out at ICRISAT Center and at a number of research institutes in our host country. This allows us to test management procedures, germplasm, and breeder material in a number of environments, the results of which may be transferred to similar situations in other parts of Asia.

Some Constraint-Orientated Activities

Peanut stripe virus is the cause of concern across Asia because of the ease of its spread via infected seed. The second major workshop dedicated to this disease was held at ICRISAT Center in Aug 1989 to allow 39 experts to discuss, among many other topics, ways of containing this refractory disease. A pleasing international note was a report presented at this workshop by a Thai virologist of the research he carried out in France that was funded by IDRC, the French, and ICRISAT.

Approximately 9000 groundnut genotypes were screened for resistance to this disease in an Indonesia ACIAR-ICRISAT project. Unfortunately, no resistance was detected. Experiments on its epidemiology and economic importance continue in Indonesia to identify alternative methods to control this disease.

The base for managing this disease has been expanded by sending aphid (vector) resistant germplasm to countries where this disease is endemic, to evaluate its performance under high infestation pressure.

Another working group to promote research on bacterial wilt of groundnut was formed at a meeting in Malaysia in 1990. Scientists from Australia, UK, USA, and Malaysia agreed to form an informal network with scientists from countries where this disease is endemic with the objective of stimulating research on the hosts, virulence, pathogenicity, and characteristics of its varied pathotypes, its epidemiology, and its management. This activity is orientated towards the needs of groundnut growers of the People's Republic of China, and of Indonesia.

Although not a constraint in the normal sense, the mycotoxins produced by *Aspergillus flavus* are of particular concern to national programs that encourage international trade in groundnut and groundnut products, including the cake that remains after oil extraction. A workshop was held at ICRISAT Center to promote the exchange of information on all aspects of aflatoxin-related problems. Full proceedings of this workshop are available.

A training course on virological techniques was held in the People's Republic of China, following visits by senior scientists from ICRISAT earlier this year. There has been an increase in interchange between this important groundnut-growing country and ICRISAT in recent years. We have been particularly pleased to welcome young scientists from China to the Cell Biology Unit where they have made an excellent impression in terms of their dedication, diligence, and the high quality of their work.

Unit Activities

It is not possible to summarize all the activities of the Groundnut Group over the last two years but some highlights are mentioned here. Further details can be found in the ICRISAT annual reports for 1988 and 1989 and in other publications available to you.

Breeding Unit. A number of ICRISAT selections have been tested extensively by Indian national program scientists in different agroecological zones of their country. Outstanding among these, in terms of yield, adaptability, and we hope in sustainability, are ICGSs 11

and 44. These are in great demand by farmers throughout the country. Other lines that are talked about in positive terms in India are ICGSs 1, 5, 21, and 76, and FDRSs 4 and 11. FDRS 4 is of particular interest because it combines disease- and insect-resistance with good agronomic features. Elsewhere in South Asia, Pakistan has released as BARD 699 a composite of ICGVs 87187 and 87128 for rainfed cultivation. A selection from ICGV 87127 (ICGS 35) has been released as Jinpungtangkong in the Republic of Korea because of its high yield, its protein and oil content, and the favorable quality of its oil.

The international nurseries and trials provide early, medium-late, disease-resistant, pest-resistant, confectionery, and drought-resistant lines for testing in the appropriate zones of cooperating countries. The trials have contained lines that can provide desirable varieties or germplasm to the countries that have tested them.

Plant protection. The pathologists have completed screening the germplasm for resistance to late leaf spot and rust. More than 200 accessions have been identified with resistance to one or both of these diseases and some have already been used successfully in the breeding program. The entomologists are now screening the same 200+ lines for resistance to defoliating and sucking insects in a continuing quest for groundnut germplasm with multiple resistance.

Early leaf spot remains a disease for which we have found no strong resistance in cultivated groundnut. High levels of resistance to this disease, however, have been found in wild species, and progress is being made in transferring the resistance genes to adapted varieties.

The entomologists have entered a cooperative program with Indian national program scientists to find resistance to soil insects with particular emphasis on white grubs. This group of insects infest the groundnut crop more severely in several Asian countries than had hitherto been realized. Field experiments at ICRISAT Center have shown that several wild species have resistance to jewel beetle, another kind of soil insect that attacks roots. Seed has been sent to the Coordinator of the All India Coordinated White Grub Programme for testing in north India for resistance to white grubs during the 1990/91 postrainy season.

Observations and experiments on the causes of insect outbreaks point clearly to excess insecticide application and drought stress as being major contributors. Reducing spray application is a matter of raising farmer awareness about the hazards of applying insecticides except when really needed. This problem is common to a number of crops in Asia. The linkage of drought stress with pest outbreaks vindicates our adoption of a multidisciplinary approach to relieving constraints to production.

The entomologists have tested a number of breeder's lines in farmers' fields for resistance to defoliators and sucking pests. We are impressed by the all-round performance of these resistant lines in the hot spots where they were tested, and welcome the opportunity to find out how well they perform under intense pest pressure in other zones. The entomologists have also decided that the ICRISAT farm is not the best place to screen for resistance to pests and would like to continue this process as a collaborative exercise with other entomologists in Asia, besides India.

The relationships between the level of *Spodoptera*, groundnut leaf miner, jassid activity, and yield can be explained. For *Spodoptera*, we can relate damage to the numbers of male

moths caught in pheromone traps several weeks earlier. Much of the foundation research linking tomato spotted wilt virus and its thrips vectors with the varied symptoms of bud necrosis disease was carried out at ICRISAT. This work is now being continued in two areas. A visiting researcher from Holland is studying resistance to this virus (joint project of the Breeding and Virology Units) and a research scholar from India is carrying out a detailed study of the disease's thrips vector (joint project of the Entomology and Virology Units). We anticipate the need to extend this study to other parts of Asia because there may be more than one vector and several distinct isolates of this disease.

Abiotic constraints. Many of the lines selected for resistance to biotic constraints have poor pod yields in long day conditions because a disproportionate amount of the photosynthate is diverted to the haulms. This recently discovered photosensitivity may explain, at least in part, why some genotypes are resistant to diseases at one location but not at another. We hope our research will help us understand the phenomenon better and eliminate or reduce its influence in our breeding material.

Drought tolerance is of prime concern to many groundnut growers. The search for resistance continues under the line-source screening at ICRISAT Center. Subsequent testing is to take place in a rain shadow area (Anantapur) south of Hyderabad. A number of varieties are now known to tolerate drought stress and are available for evaluation outside India. The mechanism of drought stress recovery is being tested so as to develop a lab-based screening procedure.

Conclusion

This has been a brief overview of the activities of the Groundnut Group as they relate to Asia. We hope that it is clear that our numbers are small, in fact much smaller than the number of groundnut scientists in many NARSs, that we have responsibilities outside the Asian region, and that we are based in an environment that is different to most of those obtaining in Southeast Asia, yet we plan our activities with the needs of Asia as a whole in mind. The next phase of our work will contain adaptive on-farm research; this will be the real test of the applicability of our work.